Evaluating complications in below-knee skin cancer surgery after introduction of preoperative appointments : A 2-year retrospective cohort study

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Methods
We searched the medical records of the HUS Dermatosurgery unit for all below-knee surgeries during 2016, when no preoperative nurse appointments were done, and compared it to 2018, when preoperative appointments for risk patients were introduced. The study included 187 patients in 2016 and 179 patients in 2018, of whom 68 (about one third) attended preoperative appointments. At the appointments, risk factors were evaluated, and compression therapy was introduced when possible.

Results
Complication rates were 13.4% in 2016 versus 10.1% in 2018 (P=0.33), despite significantly higher risks in the 2018 patient group. The odds ratio for complications for appointment attendees versus non-attendees was reduced after adjustments to 0.58; however, this was insignificant (P=0.47). The odds of complications for skin grafts were considerably higher: 11.33 versus other surgery techniques (P=0.00).

Conclusions
The introduction of preoperative appointments seems to reduce complications in below-knee surgery. For graft reconstructions complication risk is high, even with carefully planned pre- and postoperative care. Further studies are needed to evaluate preventable risk factors of below-knee graft reconstructions.

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Helsinki University Central Hospital (HUS[1]), Skin and Allergy Hospital, Dermatology Outpatient Clinic and University of Helsinki.

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Introduction

Dermatologic surgery is a relatively new expanding subspecialty within dermatology; it still needs further research regarding risk management, especially in the European setting (1). Below-knee surgery has a high risk for complications (2-5), and it has been previously stated that further studies on complication management of these common but risky interventions are needed (6). Guidelines for preoperative management in dermatology have been published (7-11), but to our knowledge, no previous studies have assessed their benefits. Based on previous medical studies, the advantages of preoperative evaluation are not easily proven scientifically (12).

Methods

We searched the medical records of HUS Skin and Allergy Hospital's Dermatosurgery unit for all below-knee surgeries during the years 2016 and 2018. The preoperative nurse appointments were introduced for at-risk patients 2-4 weeks prior to surgery in 2018. Table 1 presents the appointment objectives.

Table 1.

The study included both benign and malignant tumors. It excluded punch biopsies (n=8), as well as underlying diseases that disturb wound healing, such as pyoderma gangrenosum (n=1). If the same patient had multiple interventions, only the chronologically first intervention was documented (excluding n=59 interventions). Analyses included 366 patients after the exclusions. It included 187 patients in 2016 and 179 patients in 2018, of whom 68 patients, about one third, attended a preoperative appointment. Data about the patient or performed interventions were documented based only on HUS medical records (not, e.g., information from health care centers). The patients were instructed to contact our hospital if any complications appeared. Surgery photographs were used to specify it if the localization of the lesion was unclear based on medical records.

We assessed the benefit of preoperative appointments by comparing complication risk year 2016 versus 2018. We compared the OR^2 for complications with and without a preoperative appointment, adjusted for multiple covariates. We also compared the complication risk for different surgery techniques.

Complications were classified as infection, delayed wound healing, necrosis, bleeding or scar issue. Wounds were documented as infected if they had purulent discharge, if antibiotics were prescribed or if infection was mentioned. Prolonged wound healing without these signs was documented as delayed wound healing. This complication group also included wound dehiscence.

The covariates we documented were age, sex, BMI[3] if known, smoking status, diabetes diagnosis, working status, immunosuppressive or anticoagulative/antithrombotic medication, walking aid use, diagnosed peripheral vascular or lymphatic disease, lower limb edema, malnutrition, previous chronic ulcers, surgery diagnosis, technique and localization.

We recorded the use of pre/postoperative antibiotics, compression therapy or given immobilization or nutritional advice. We recorded surgery techniques as slack or strained primary closure, flap reconstructions, FTSGs[4] or secondary intention healing and locations of the tumor as toes, foot, malleoli, lower 1/3-3/3 of leg below-knee. We also documented postoperative departmental care and sick leaves, as well as additional postoperative appointments. The study protocol has been approved by the HUS Ethical Review Committee.

Statistical methods

Bivariate analysis, conducted using chi-squared tests (Fisher exact), was used to assess complication risks for different patient groups, and independent samples were T-tested to assess their statistical significance. We calculated adjusted ORs for complications by multinomial logistic regression. ROC[5] was calculated to retrieve the cut-off point for the age at which the complication risk significantly rose, maximizing Youden's index. The results are presented as OR and their 95% CI[6]. $P<0.05$ was considered statistically significant.

Results

Table 2.

Complications year 2016 versus 2018

The overall complication rate was 13.4% in 2016 and 10.1% in 2018, but the difference was statistically insignificant with P=0.33 (95% CI -0.33–0.99). The 2016 patient group versus 2018 had a statistically significant difference regarding their ability to walk without aid (P=0.01) and regarding the number of patients with leg edema (P=0.03). Other covariates showed no significant difference. The patient mean age was 64.1 in 2016 versus 66.3 in 2018 (P=0.24). The mean number of postoperative, additional nurse appointments reduced from 0.65 to 0.43 (P=0.19 (-0.11–0.56)) from 2016 to 2018.

Figure 1.

Complications for preoperative appointment attendees versus non-attendees

The OR for complications in patients attending the preoperative appointment versus those without a preoperative appointment was 2.11 (P= 0.04, 1.04–4.31) without covariate adjustments. After full adjustments, the OR for complications was lower 0.58 (P=0.47, 0.14–2.49) for patients attending the appointment. There were differences in these two groups of patients, which was statistically significant regarding their age (P=0.00), working status (P=0.00), ability to walk without aid (P=0.04), leg edema, vascular or lymphatic diseases (P=0.00) or number of FTSGs (P=0.00).

Complication rates for different surgery techniques

FTSGs had 12.2 higher odds for complications versus other surgery techniques (P=0.00, 6.01–24.59). After full adjustments, the ORs were 11.3 higher (P=0.00, 2.98–42.48). The complication rate for FTSGs was higher in 2016, with 44% versus 34% in 2018, but their difference was insignificant (P=0.44). We also saw no significant difference in complications for appointment attendees versus non-attendees with FTSG reconstructions (50%

versus 33%, P=0.18), when including both 2016 and 2018 patients. Flap repairs had 8.0 higher odds for complications, but the small number of flap reconstructions (n=8) limits the reliability of this result.

Table 3.

Figure 2.

Factors influencing complication risk

Regarding complication risk, these covariates were significant: age > 80 (P=0.00), FTSG (P=0.00) and flap reconstructions (P=0.00). When also including P values 0.05-0.20, immunosuppressive medication (P=0.08), sex (P=0.09), leg edema (P=0.13), squamous cell carcinoma (P=0.13) and ulcer history (P=0.15) seemed to have an impact on complication risk. Age 80 was chosen as the cut off point for higher complications risk by calculating area under the curve. The maximized sensitivity (49%) and specificity (20%) was at age 79.5. The specific tumor location showed no significant effect on complication risk (P=0.46).

Table 4.

Prophylactic measures

Figure 3 presents the percent of patients receiving different prophylactic measures. Prescribed pre- or postoperative compression therapy, antibiotics, immobilization instructions or sick leaves are presented separately for each year, as well as the number of patients with pre- or postoperative departmental care. The use of both pre- and postoperative compression therapy increased significantly (P= 0.00), as well as the number of immobilization instructions (P= 0.00).

Figure 3.

Additionally, we calculated the odds ratio for complications after postoperative compression versus without compression in a population with peripheral disease (leg edema, vascular or lymphatic disease). Odds for complications in the crude model were 1.41 (P=0.67, 0.29–6.85) and after full adjustments 0.67 (P=0.74, 0.061–7.19), showing a decline in complication, although this was insignificant.

Discussion

Previous studies have reported that the risk for postoperative complications within dermatologic surgery has been between 0.7 and 29 %, with some studies separately focusing on, e.g., below the knee, dermatology inpatients or FTSGs, all factors significantly influencing complication risk (1,6, 14-17). The risk for infection has been between 1.3–8.7% (5, 18) and exclusively for below-knee operations up to 30% (2, 4, 6, 19). In addition, a poor preoperative skin condition and tumor ulceration (20), and patient characteristics like diabetes (21), smoking (16, 22) and age (3, 20) are considered risk factors for SSIs[7]. Flap and graft reconstruction are the types of surgeries associated with the highest risk for SSI (1, 19). Grafts taken in lower leg surgeries have been reported with rates of 64–90%, depending on the study (14, 23, 24). The risk for bleeding complications has previously been reported between 0.3–3% (1, 5, 17) and for necrosis 1,7–8.6% (1, 5).

Honaker et al. (6) evaluated the complication risk of 69 patients in below-knee MOHS surgery, with an overall complication rate of 17%, of which 50% were infections, 3.25% delayed wound healing, 2,17% hypergranulation and 8% hypertrophic scars. The overall complication rate was lower in our study (13.4% and 10.1% the different years); however, our study also included primary closure surgeries, which probably reduce the risks. To our knowledge, other studies that exclusively evaluated below-knee surgery complications assessed only infection risks, not risks for different complications. Overall, the complication rates in our study are quite well in line with previous studies. An infection rate of 4.9% is quite low, but we separately documented delayed wound healing without infectious signs (4.6%). The necrosis rate (1.6%), bleeding complications (0%), and documented scar issues (0.5%) were also low.

Complications in the year 2016 versus 2018

A general consensus exists that a careful preoperative evaluation reduces complication risks, especially in below-knee surgery that contains patient-related risks for complications such as leg edema and ischemia. In our study, postoperative complications were reduced from 13.4% to 10.1% after introducing preoperative appointments, although the difference was not statistically significant. A previous study assessing the benefits of preoperative

appointments also had difficulties showing significant results and discussed the possible reasons (12). Factors probably influencing the results of our study were differences in patient-related risks during 2016 and 2018. There were significantly more patients in 2018 with leg edema and without the ability to walk without aid, and the population was older. However, it is possible that leg edema was documented more precisely that year. It is also possible that the differences in complication rates were not significant due to the relatively low number of patients in this study.

Our results could have been biased by the risk that patients were in touch with other health-care units when suffering complications, reducing the documented number of complications. The additional focus on complications and complication management in 2018 may have caused that more patients contacted us regarding their complications in 2018 than in 2016. This may have led to a higher complication rate in 2018 in comparison with 2016, negatively influencing the benefits of preoperative appointments.

We evaluated patient groups that would specifically benefit from preoperative appointments based on their complication risks. Table 4 list them. We probably would see the benefits of preoperative appointments even more clearly by applying this recommendation at our clinic.

Complications for preoperative appointment attendees versus non-attendees

The appointments did not significantly reduce the complication risk when we assessed complication risk for preoperative appointment attendees versus non-attendees. In fact, when not taking confounding factors into account, the complication risk for appointment attendees was higher. This result is likely biased by the fact that at-risk patients particularly were chosen for the preoperative appointments. We noted significant differences regarding the patients' ages, working status, ability to walk without aid, leg edema, vascular or lymphatic diseases and the number of FTSGs for appointment attendees. The risk for this bias could be decreased using a randomized control trial (RCT) study design, although ethical issues may limit the possibilities in this regard.

Complication rates for different surgery techniques

The complication rate in FTSGs was high, with the OR for complications 11 times higher than for other reconstruction techniques, even with preoperative appointments and, thus, carefully planned care. Complications were even more frequent for flap reconstructions than for FTSGs (Figure 2), although the low number of flap constructions (n=8) limits the reliability of these results. Further studies may be warranted to investigate the prevention of complications in FTSG surgery. Here, NPWT[9] after FTSG would be a possible approach. NPWT is widely used to treat acute and chronic wounds (25). Some studies show a positive effect of NPWT on postoperative wound healing, but the evidence is still limited with a need for larger RCT studies (25-27).

Conclusions

Although we could not observe a statistically significant effect of the preoperative appointments in below-knee surgical complications, we still believe in the need to focus on pre- and postoperative care. We saw a significant rise in the number of immobilization instructions given and in pre- and postoperative compression therapy (Figure 3). These factors are seen as important interventions to limit complications in lower limb surgery (28, 29). Pre- and postoperative interventions may have played a significant role in this study in reducing complications during 2018.

In conclusion, our study showed that there seems to be a benefit from preoperative nurse appointments in below-knee surgery, especially for at-risk patients. Leg edema is a frequent finding in the elderly population, and the introduction of compression therapy before surgery may be costeffective in this regard. The cost of treating complications is usually significantly higher than those of preventive measures, which has been clearly demonstrated in pressure ulcer (30) and wound care (31) studies. Treating complications will cause multiple additional postoperative appointments, increasing treatment costs remarkably. Smoking cessation, which clearly reduces surgical complications (32), is another example of successful complication prevention. Dermatosurgery is a continuously expanding field, so there is a clear demand for further studies concerning the cost effectiveness of preoperative nurse appointments, patient education and lifestyle advice before surgery.

Acknowledgements

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Footnotes

BMI[3]= Body Mass Index CI[6]= Confidence Intervals FTSG[4]= Full-thickness skin graft HUS[1]= Helsinki University Central Hospital NPWT[9]= Negative Pressure Wound Therapy OR[2]= Odds Ratio RCT[8]=Randomized Controlled Trial SSI[7] = Surgical Site Infection ROC[5]= Area under the curve

Figure legends

Figure 1. Incidence (%) and numbers (n) of different complications in 2016 and 2018. Overall complication rate, infection and delayed healing rates decreased in 2018.

Figure 2. Complication incidence (%) and numbers (n) for different surgery techniques in 2016 and 2018. Complication rates were high for flap and FTSG surgeries. 2018 complication rates for FTSGs decreased. For flap reconstructions, the result is limited by a small number of patients (n=8).

Figure 3. Prophylactic measures in %. 2018 pre- and postoperative compression therapy became more common (P=0.00 and P=0.00) and immobilization instructions were amplified (P=0.00).

Table 1. Preoperative appointment objectives.

- Informing the patient: Planned intervention, pre- and postoperative care.
- Collecting information about the patient: Medication (especially anticoagulative/thrombotic), allergies and medical history (peripheral diseases, valve prosthesis, diabetes, etc.).
- Determining surgery technique (consulting the surgeon).
- Preparing treatment area: Initializing treatment of leg edema (consulting the surgeon or a physiotherapist when needed), eczema or infections.
- Initializing treatment of malnutrition and supporting smoking cessation.
- Planning postoperative care:
    - Length of immobilization, compression treatment and sick leave.
    - Need of departmental care, walking aid or home care.

Table 2. Study material.

- Mean age 65 years
- Mean BMI 26
- 62 % women
- 36 % working
- 87 % walking without aid
- 7 % smoking
- 15 % diabetes diagnosis
- 30 % anticoagulative/antithrombotic medication
- 9 % immunosuppressive medication
- 30 % peripheral vascular or lymphatic disease/lower limb edema
- 3% previous chronic ulcer
- Surgery diagnosis: 19% melanoma, 27% basal cell carcinoma, 12% squamous cell carcinoma, 43% others (skin cancer precursors: melanoma in situ, benign tumours, dysplastic nevi).

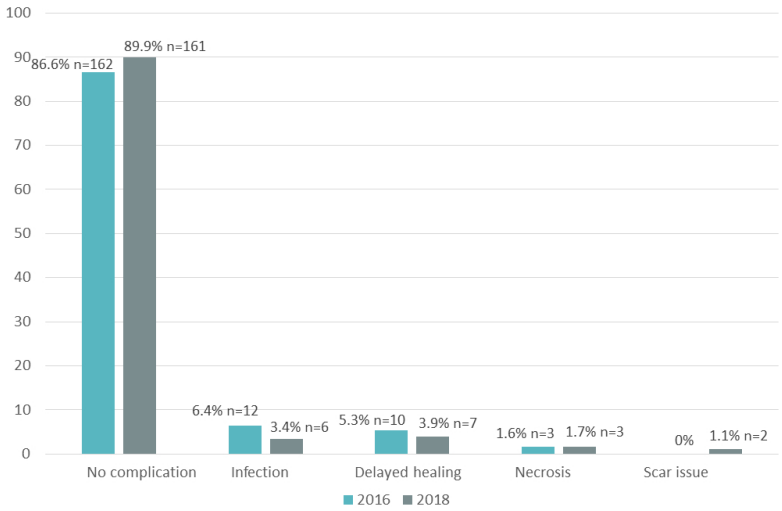
Table 3. OR for complications for different surgery techniques. Significant results bolded.	
Surgery technique	OR, (P, 95% CI)
Slack primary closure	**0.072 (0.00, 0.025–0.21)**
-full adjustment	**0.046 (0.00, 0.01–0.22)**
Strained primary closure	0.69 (0.38, 0.31–1.56)
-full adjustment	1.53 (0.45, 0.51–4.63)
Flap	**8.00 (0.013, 1.56–41.0)**
-full adjustment	(n not enough)
FTSG	**12.16 (0.00, 6.01–24.6)**
-full adjustment	**11.26 (0.00, 2.98–42.5)**

Table 4. Patient groups that benefit from a preoperative appointment based on higher complication risk (P < 0.2).

- Age > 80 (P= 0.00)
- Flap or FTSG reconstructions (P=0.00)
- Immunosuppressive medication (P=0.08)
- Male sex (P=0.09)
- Lower limb edema (P=0.13)
- Squamous cell carcinoma (P=0.13)
- Previous chronic ulcer (P=0.15)

Key messages

- Below-knee skin cancer surgery has a high risk for complications.
- This study's aim was to assess the impact of nurse preoperative appointments on below-knee surgery complication risks; assessing 366 below-knee surgery patients.
- The results show a trend towards complication reduction in 2018 when the appointments were introduced (10.1% versus 13.4%, P=0.33) and towards complication reduction for appointment attendees by odds ratio 0.58 (P= 0.47) after full adjustments.
- Below-knee skin graft reconstruction showed a 11.3 times higher odds ratio for complications versus other surgery techniques (P=0.00).
- Patient groups that benefit from a pre-operative appointment based on higher complication risk (P<0.05) are patients over 80 years of age and those with flap or graft reconstructions.



Incidence (%) and numbers (n) of different complications in 2016 and 2018. Overall complication rate, infection and delayed healing rates decreased in 2018.

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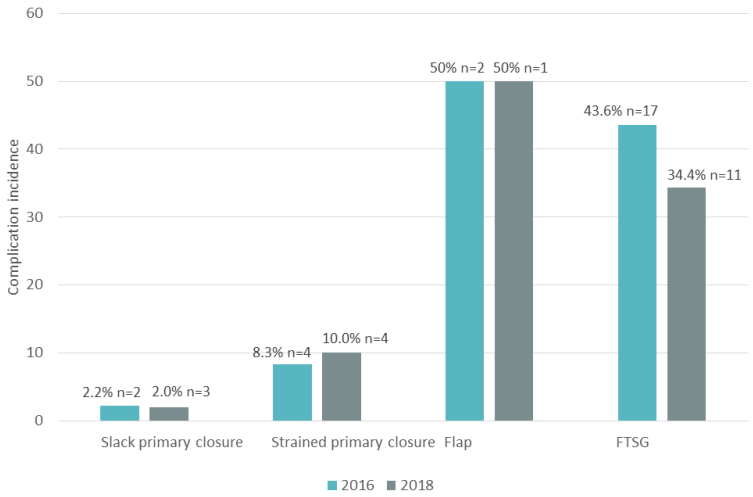

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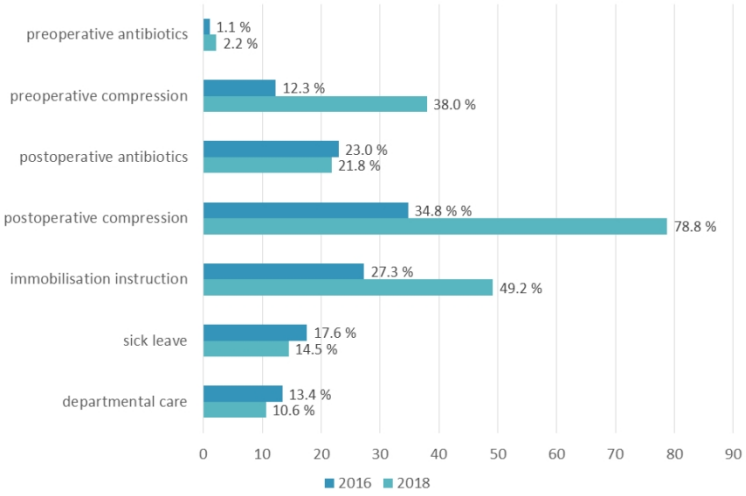

Prophylactic measures in %. 2018 pre- and postoperative compression therapy became more common (P=0.00 and P=0.00) and immobilization instructions were amplified (P=0.00).

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